

# Status and Operations at the Clouds and the Earth's Radiant Energy System (CERES) Ocean Validation Experiment (COVE) – Also a Baseline Surface Radiation Network (BSRN) Station

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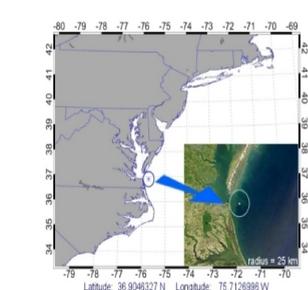
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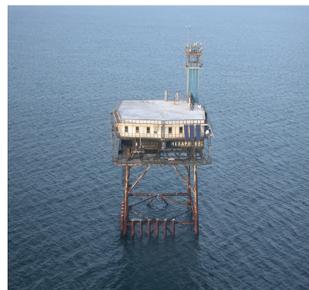
Clouds and the Earth's Radiant Energy System (CERES) Ocean Validation Experiment (COVE) website: <http://cove.larc.nasa.gov/>

## Introduction:

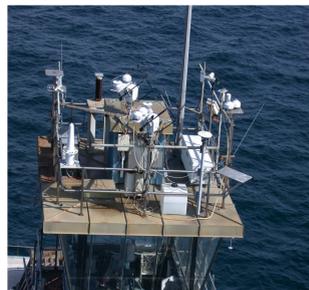
- COVE, located at Chesapeake Lighthouse, was established in 1999 as a surface validation site for CERES and other satellites.
- First data collection for BSRN began May 1, 2000 – Present.
- A table is provided of current instruments and measurements.
- Data analysis is shown for select measurements collected within the last 5 years.
- Photos of COVE's location, instrumentation and the tower effect issue we have for our downlooking instruments are presented.



Latitude: 36.90N  
Longitude: 75.71W



COVE is located approximately 25 km off the coast of Virginia Beach, Virginia.



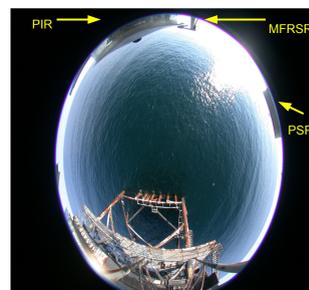
Uplooking instruments on the tower top. Elevation: ~36 meters.



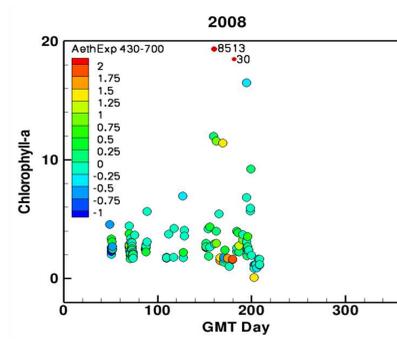
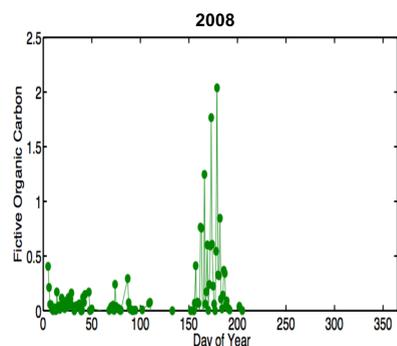
Downlooking instruments: MFRSR, Eppley PIR and Kipp and Zonen PSP. Elevation: ~21 meters.



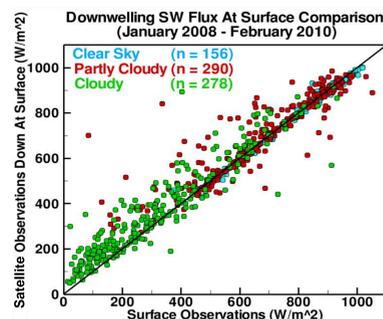
Tower shading effect in the upwelling irradiance field of view.



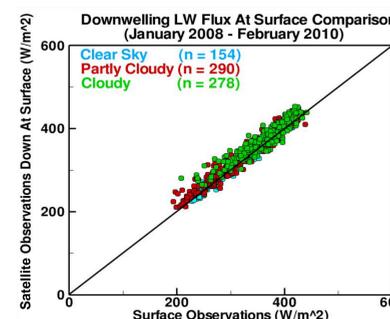
Fish-eyed lens view of downlooking instruments. Note the tower in the field of view of all 3 downlooking instruments (PIR, PSP and MFRSR).



A wildfire affected measurements at COVE in June-July 2008. The above plots show 2 different measurements affected by the smoke from the wildfire. **LEFT:** Our 7 wavelength Aethalometer measures Black Carbon (BC) and is tuned for conventional pollution. Organic Carbon (OC) aerosols cause smoke to have greater absorption in the UV than conventional pollution. Therefore, Fictive OC = BC (370 nm) – BC (700 nm). Here, Fictive OC clearly indicates fires are present and makes a nice tracer. **RIGHT:** Chla-a (Chlorophyll-a) is measured with our Seaprisim Cimel, part of AEROSOL ROBOTIC NETWORK (AERONET)-Ocean Color. The smoke caused anomalously high readings to be measured and may confound satellite retrievals of Chla-a as well.



Sky Condition	Y = mx + b	R <sup>2</sup>	Mean Bias	Standard Deviation
Clear	Y = 0.995x + 0.845	0.991	-3.1	15.9
Partly Cloudy	Y = 0.802x + 158.506	0.837	23.1	82.6
Cloudy	Y = 0.898x + 77.259	0.885	45.3	73.2

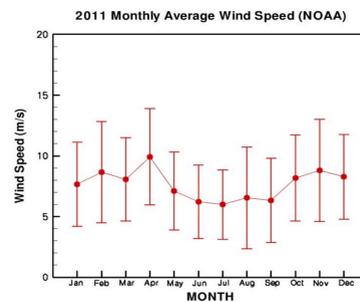
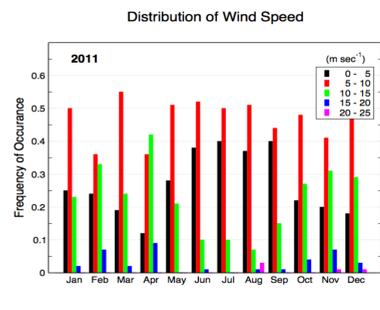
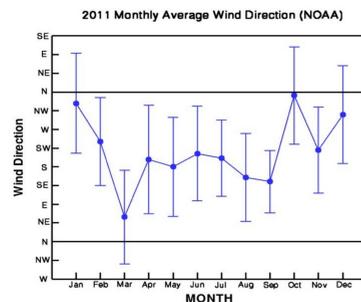
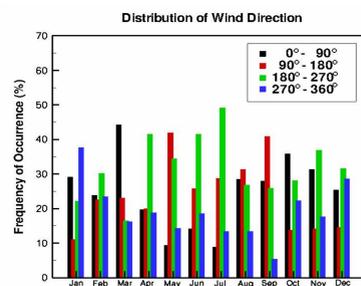


Sky Condition	Y = mx + b	R <sup>2</sup>	Mean Bias	Standard Deviation
Clear	Y = 1.015x - 1.915	0.974	2.6	9.5
Partly Cloudy	Y = 0.975x + 19.944	0.951	11.8	13.5
Cloudy	Y = 0.859x + 63.565	0.876	12.8	15.6

Statistics of coincident surface observations at COVE and CERES Cloud and Radiation Swath(CRS) Model-B retrieval from the Terra Satellite about the X=Y lines for total shortwave (SW) and longwave (LW) surface radiation, separated by sky condition. Model-B was developed at NASA Langley Research Center and works under all sky conditions. Both the SW and LW comparisons have very good correlation. The distribution of statistics are best under clear skies.

Measurement	Atmosphere (A) OR Ocean (O)	Units	Instrument	Wavelength (nm)	COVE Database?
Direct Shortwave Irradiance	A	W/m <sup>2</sup>	Kipp and Zonen Pyrheliometer (CH1)	200-4000	Yes
Diffuse Shortwave Irradiance	A	W/m <sup>2</sup>	Kipp and Zonen Pyranometer (PSP)	200-4000	Yes
Global Shortwave Irradiance	A and O	W/m <sup>2</sup>	Kipp and Zonen Pyranometer (PSP)	200-4000	Yes
Longwave Irradiance	A and O	W/m <sup>2</sup>	Eppley Pyrometer (PIR)	5000-50000	Yes
PAR Irradiance	A	mV	Li-Cor PAR	400-700	Yes
Global and Diffuse Narrowband Irradiance	A and O	W/m <sup>2</sup>	Yankee Multi-Filter Rotating Shadowband Radiometer (MFRSR)	415, 496, 614, 671, 868 and 939	Yes
Direct and Diffuse Narrowband Radiance	A		AERONET sunphotometer	412, 443, 490, 532, 551, 667, 870 and 1020	No (AERONET Database)
Normalized Water Leaving Radiance	O	mW/(cm <sup>2</sup> sr um)	AERONET sunphotometer	413, 441, 489, 530, 551, 668, 869 and 1020	No (AERONET Database)
Aerosol and Cloud Vertical Structure	A		Micro-Pulse Lidar (MPL)	523	No (MPL Network)
Total Column Precipitable Water Vapor	A	cm	Global Positioning System (GPS) Meteorology		No (NOAA's GPS-MET Network)
Black Carbon	A	µg/m <sup>3</sup>	Magee Scientific Aethalometer	370, 430, 470, 520, 565, 700 and 950	Yes
Light Scattering Extinction Coefficient	A	1/m	Radiance Research Nephelometer	530	Yes
Sky Temperature	A	Kelvin	Heitronics Infrared Thermometer	9600-11500	Yes
Sea Surface Temperature	O	Kelvin	Heitronics Infrared Thermometer	9600-11500	Yes
Air Temperature	A	°C	Rotronic Temperature Sensor		Yes
Relative Humidity	A	Percent	Rotronic Relative Humidity Sensor		Yes
Barometric Pressure	A	millibar	Vaisala Pressure Sensor		Yes
Wind Speed and Wind Direction	A	m/s and 0-360°	Young Wind Speed and Direction Sensor		Yes
Rain Sensor	A		SKYE rain sensor		Yes

Current measurement collection at COVE. Most of these instruments have a backup collecting at the same time in case one fails. This data can be found on the COVE website located here: <http://cove.larc.nasa.gov/COVE-DataDownloadTool.shtml>



Wind farm suitability studies are gaining momentum off the coast of Virginia and near Chesapeake Lighthouse, where the National Oceanic and Atmospheric Administration (NOAA) has close to 3 decades of both wind direction and wind speed measurements. An example of wind direction data for 2011 is shown here.

Consistent offshore winds are interesting for renewable energy purposes. Chesapeake Lighthouse winds, on average, exceed 5 m/s, which is the general requirement for wind power. 2011 data is shown above.

## Moving Forward:

- Chesapeake Lighthouse has been transferred to the U.S. Department of Energy (D.O.E.) from the U.S. Coast Guard as of October 1, 2012.
- The D.O.E has plans to renovate Chesapeake Lighthouse for offshore wind research and this could take up to 2+ years to complete.
- Temporary research sites are being investigated at this time to determine the feasibility of installing instruments similar to those at COVE until renovations are complete at Chesapeake Lighthouse.
- Measurements (primarily BSRN) will continue at COVE until the renovation efforts commence.

## References:

- We thank AERONET and Brent Holben for their effort in establishing and maintaining their sunphotometer at COVE.
- Wind data were obtained from NOAA's National Data Buoy Center (NDBC).
- The Downwelling SW and LW data were obtained from the NASA Langley Research Center Atmospheric Science Data Center.